

# Industrial Technologies Program



## Fibrous Fillers to Manufacture Ultra High Ash/Performance Paper

New fibrous filler technology to manufacture paper promises equal or better paper quality and performance at a lower cost

Increasing global competition, fiber shortages, and environmental and ecological concerns force U.S. papermakers to constantly work to reduce production costs and environmental load. Mineral fillers which increase paper brightness and opacity and improve the paper's print quality have reduced costs by replacing wood fiber. However, filler loading has been limited to 15% - 20% because higher levels cause a loss of sheet strength and bulk as well as "dusting" during printing.

G.R. International (GRI), in cooperation with several major industrial part-

ners, has developed a new fibrous filler that may overcome these problems and achieve additional replacement of high-cost wood fiber. GRI and its collaborators will study the reaction mechanism of the new filler to characterize and optimize it for manufacture and application methods. The new fillers will ultimately produce a composite paper containing up to 50% ash with equal or better performance characteristics than conventionally attainable. The fibrous fillers will also lead to better retention of fillers, additives, and pulp fines, resulting in significantly reduced biological and chemical oxygen demands (BOD and COD) in the mill process water.

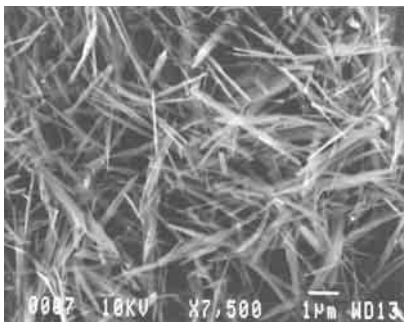
### Benefits

- 25% energy use reduction
- Expensive filler ( $\text{TiO}_2$ , Silica) replacement
- Basis weight reduction
- Cost savings between \$10 to \$50 per ton of paper produced
- Additional revenue of \$50 to \$100 per ton in new products
- Improved retention and reduced BOD, COD, and turbidity in mill process water

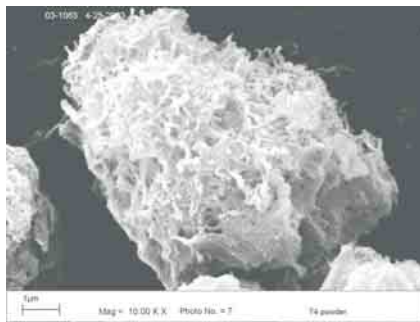
### Applications

Fibrous fillers could be used in all paper and board products. Free sheet papers are the most likely targets near term, but wood-containing papers and even newsprint could eventually use this product as well.

### S.E.M. of Fibrous Fillers



High Bulk & Performance  
Silicate Micro-Fiber



Ultra High Bulk Silicate  
Macro Structure

## Project Description

**Goal:** Validate the techno-economic viability of the fibrous filler technology in order to manufacture paper containing up to 50% ash, at equal or better quality and performance and at a lower cost.

The chemical reaction forming the new fibrous fillers will be carried out in both GRI's lab and Lawrence Livermore National Laboratories' lab (LLNL). The resulting fibrous fillers will then be characterized and tested for quality. The manufacturing process for the fibrous fillers will be optimized by studying the reaction mechanism. Alternate raw materials and process additives will be studied to further enhance paper properties and/or lower costs. The filler manufacturing process and paper enhancing capabilities will be optimized in a scaled-up pilot reactor. The fibrous fillers will then be added to the wet end for paper formation. The effect of the new fillers on the paper properties and process parameters will be studied. Interfacial bonding, paper structure, fiber modification, coating formulations, paper performance, print quality, and mill balances will all be used to optimize the ultra high ash paper produced with up to 50%

fibrous filler. Production trials will take place at Weyerhaeuser and Grays Harbor Paper, LLP to produce the final fibrous filler-optimized paper. The final paper produced containing the fibrous fillers will be submitted to multiple end-users for market evaluation.

## Progress and milestones

- GRI had developed a series of calcium-silicate-based fibrous fillers which are high in aspect ratio (10:1 to 100:1), large in particle size, and extremely low in bulk density.
- One of GRI's fibrous fillers, TiSiI, has been shown to outperform sheets filled with an equivalent amount of PCC or PCC plus  $\text{TiO}_2$  blends.
- Extensive preliminary results have been collected in GRI's laboratory and in pilot plant studies in conjunction with several paper company evaluators.
- Preliminary fibrous filler result data have demonstrated the potential for much higher filler contents with equal or better sheet properties than conventional fillers.

## Project Partners

Western Michigan University  
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Lawrence Livermore National Laboratory  
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## A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



U.S. Department of Energy  
**Energy Efficiency  
and Renewable Energy**

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